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CLOSURE WITH VENTS FOR VENTING DURING MOLDING OF A LINER, METHOD OF FORMING A LINER IN A CLOSURE, AND DEVICE FOR FORMING A LINER IN A CLOSURE

FIELD OF THE INVENTION

The present invention relates to a method and device for venting gas during molding of a liner in a closure.

BACKGROUND INFORMATION

U.S. Patent No. 4,274,822 refers to an apparatus for forming seal liners of thermoplastic material within closure cap shells. The apparatus is purported to include a plurality of movable dies each having an inner die and an annular outer die, both of which are movable up and down in relatively slidable relation with each other and arranged so that the inner die takes it lowermost position after the outer die has taken its lowermost position. A downward movement of the outer die is restricted so that a constant clearance may be maintained between its lower end and an internal surface of a cap shell to be worked with, and so that an annular foaming chamber of a constant capacity is formed beneath the lower end of the outer die. A plurality of gas discharging grooves are provided so as to be communicated with the foaming chamber.

U.S. Patent No. 5,332,381 refers to an apparatus for forming liners of thermoplastic material within closure shells. The apparatus is purported to include a movable die having an inner punch member and an annular outer mold member, both of which are moveable up and down in relatively slidable relation with each other and arranged so that the inner punch takes its lowermost position after the outer mold member has taken its lowermost position. As the inner punch moves into its lowermost position, thermoplastic material is forced through radial grooves so that a thick

annular pad portion of seal liner may form beneath the lower end wall of the outer mold member.

U.S. Patent No. 5,800,764 refers to an external venting method for forming a closure liners, in which venting means are provided by a plurality of venting passages formed in an outer surface of a liner sleeve of a liner-forming assembly when properly positioned within the closure. A liner tip coaxially disposed in the sleeve is advanced to compress a moldable plastic liner-forming material between the closure, the liner tip, and the sleeve, so that gas may vent therefrom to a region external to the sleeve.

SUMMARY

The present invention provides a method and device for forming a liner in a closure, in which a configuration of spaced pads or stand-offs in a top wall of the closure may facilitate venting of air or other gases during compression molding of a liner material against the top wall. Since the spaced pads or stand-offs are configured as part of the closure itself, the liner-molding device used to compress the liner material may be more flexibly designed for use with a wide range of closure configurations, and therefore may need not be re-configured to accommodate varying and/or future closure configurations.

According to an exemplary embodiment of the present invention, a closure having a top wall, a circumferential skirt downwardly extending from the top wall, and an outer band extending from the skirt, includes a series of spaced pads or stand-offs which form unobstructed spaces or gaps to vent gas during compression of a liner-forming material by a liner-molding device. The spaced pads may be arranged to engage an outer punch of the liner-molding device so that gas that would otherwise be trapped between the top wall and the liner-molding device may escape via the spaces between

the pads. In this regard, the outer punch of the liner-molding device may have, for example, a flat face.

According to an exemplary method of the present invention, an axially movable inner punch of the liner-molding device is arranged with the inner circumference of the outer punch. During molding of the liner, the outer punch engages the pads formed in the top wall of the closure, an amount of moldable material is applied to the top wall of the closure, and the inner punch is extended to compress and form the liner from the moldable material. During compression of the liner, gas that would otherwise be trapped may be ejected through the gaps formed between the pads.

In accordance with an example embodiment of the present invention, a closure device include a top wall, a skirt depending from the top wall, and a plurality of pads arranged circumferentially on the top wall. The pads extend into a space formed by the top wall and the skirt, and the pads are configured to vent gas between adjacent pairs of pads during molding of a liner material against the top wall.

The pads may be configured to engage a face of an outer punch of a liner-molding device during compression of the liner material against the top wall by an axially movable inner punch of the liner-molding device. The face of the outer punch may be essentially flat.

The pads may be radially oriented on an inner surface of the top wall, and the inner surface of the top wall may be one of circular, oblong, elliptical, parabolic, spiral, and spherical.

The skirt may include threads configured to interact with a threaded portion of a container neck.

The closure device may include a tamper indicating band arranged on the skirt.

The closure device may be made of one of a rigid and semi-rigid material, e.g., plastic, polypropylene, etc.

The closure device may be constructed as a single piece.

In an example embodiment of the present invention, a method of forming a liner in a closure device, includes applying a moldable material to a top wall of the closure device, engaging a face of a punch of a liner-molding device with pads arranged on the top wall, the pads extending into a space formed by the top wall and a skirt depending from the top wall, compressing the moldable material by the punch against the top wall to form the liner, and venting gas between adjacent pairs of pads during the compressing step. The punch may include a flat face. The moldable material may be compressed in the compressing step against the top wall by extending an axially movable inner punch of the liner-molding device. The method may including forming the closure device, e.g., by molding, e.g., injection molding.

In an example embodiment of the present invention, a closure includes a top wall, a skirt depending from the top wall, and venting means arranged circumferentially on the top wall for venting gas during molding of a liner material against the top wall.

In an example embodiment of the present invention, a device for forming a liner in a closure includes means for applying a moldable material to a top wall of the closure device, means for engaging pads arranged on the top wall, the pads extending into a space formed by the top wall and a skirt depending from the top wall, means for compressing the moldable material against the top wall to form the liner, and means for venting gas between adjacent pairs of pads during the compression of the moldable material against the top wall.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1A illustrates a perspective view of a closure according to an exemplary embodiment of the present invention.

Figure 2 illustrates a bottom view of the exemplary closure of Figure 1.

Figure 3A illustrates a cross-sectional view of the exemplary closure of Figures 1 and 2 along designated section A-A in Figure 2.

Figures 3B illustrates a cross-sectional view of the exemplary closure of Figures 1 and 2 along designated sections B-B of Figure 2 during compression of a liner material using a liner-molding device.

Figure 3C illustrates a cross-sectional view of the exemplary closure of Figures 1 and 2 along designated section C-C of Figure 2 during compress of a liner material using a liner-molding device.

Figure 4 illustrates a cross-sectional view of the exemplary closure of Figures 1 and 2 engaged with a liner-molding device.

Figure 5 illustrates an enlarged cross-sectional view of the exemplary closure.

DETAILED DESCRIPTION

Figures 1 and 2 illustrate a closure 100 according to an exemplary embodiment of the present invention. In particular, Figure 1 illustrates a perspective view of the closure 100, and Figure 2 illustrates a bottom view of the closure 100.

Closure 100 includes a top wall 1, a skirt portion 2 depending from the top wall and extending downwardly, and an outer band 3 arranged on an outer edge of the skirt portion 2. The top wall 1 includes a series of spaced pads or stand-offs 5 which form gaps 6 that may be used to vent air or other gases during compression of a liner material

against the top wall 1. The pads 5 are configured to engage a liner-molding device during compression of a liner material against the inner surface of the top wall 1 so that air or other gases that would otherwise be trapped between the top wall 1 and the liner-molding device may escape via the gaps 6 formed between the pads 5. Accordingly, the liner-molding device need not be specifically configured to accommodate the release of the trapped gas.

The pads 5 are illustrated as arranged radially and evenly spaced around the circumference of the inner surface of the top wall 1. In this regard, the exemplary closure 100 is configured with twelve pads 5, however, more or fewer pads 5 may be provided. Other suitable arrangements, pad spacing, pad location, etc. may also be provided depending the configuration of the particular closure and/or liner-molding device used to compress the liner material. For example, the top wall 1 is illustrated as circular in shape, although any suitable shape may be provided, including, but not limited to, oblong, elliptical, parabolic, spiral, spherical, etc.

The inner sidewall of the skirt portion 2 includes threads 4 which may interact with a threaded portion of a container neck to retain the closure on a container. In this regard, the exemplary closure 100 may be applied, for example, with standard capping equipment to glass bottles or plastic bottles, including those made to standard industry tolerances and government regulations.

The outer band 3 may be configured as a tamper-indicating band to indicate to a consumer, for example, if the container has been opened or otherwise tampered with. In this regard, the outer band 3 may include extending tabs and may be frangibly connected to the skirt portion 2 so that when the closure is removed from a container for the first time, the tabs contact a shoulder of the container and cause the outer band 3 to separate from the skirt portion 2.

A tab arrangement and tamper-indicating band, such as that described, for example, in U.S. Patent No. 6,371,317, which is expressly incorporated herein in its entirety by reference thereto, may be provided.

The exemplary closure 100 may be made of any appropriate rigid or semi-rigid material, including, for example, hard plastic, polypropylene, etc., and may be constructed, for example, in one piece using a single injection molding process. Moreover, the exemplary closure 100 may be suitable for a wide variety of liner materials and/or liner-forming assemblies. For example, the exemplary closure 100 may be suitable for liner-forming assemblies that include flat or smooth faces whose cleanliness and integrity may be more easily maintained, thereby improving overall quality and/or reducing defect rates. The exemplary closure 100 may also be suitable to accommodate future innovations in closure and/or liner-forming assembly design so that such innovations are not unnecessarily restricted or delayed.

Figure 3A illustrates a cross-sectional view of the exemplary closure 100 of Figures 1 and 2 taken along the line A-A in Figure 2. As illustrated, the arrangement of pads and gaps arranged on the top wall 1 may not interfere with other elements of the exemplary closure 100, including, for example, the skirt portion 2, the outer band 3, and threads 4. In this regard, elements of the exemplary closure 100 may be freely designed to suit other and/or additional requirements. For example, the threads 4 may be freely designed to accommodate a wide variety of container connections.

Figures 3B and 3C illustrate cross-sectional views of the exemplary closure 100 of Figures 1 and 2 taken along the lines B-B and C-C of Figure 2 during compression of a liner material using a liner-molding device. In particular, Figure 3B illustrates a cross-sectional view of the

exemplary closure 100 taken along the line B-B, and Figure 3C illustrates a cross-sectional view of the exemplary closure 100 taken along the line C-C.

As shown, an outer punch 7 of the liner-molding device has a flat face arranged to engage the spaced pads 5 during molding of the liner. An axially movable inner punch 8 of the device is arranged within the inner circumference of the outer punch 7. During molding of the liner, the outer punch 7 engages the pads 5 formed in the top wall 1, an amount of moldable material is applied to the top wall 1, and the inner punch 8 is extended to compress and form the liner from the moldable material. During compression of the liner, gas that would otherwise be trapped between the inner punch surface 8a, the outer punch 7, and the top wall 1, is ejected through gaps 6.

Figure 4 illustrates a cross-sectional view of an exemplary interaction of the closure 100 of Figures 1 and 2 and a liner-molding device. A gap 6 formed between spaced pads 5 arranged on the inner surface of the top wall 1 forms a space for gas to escape during compression of a liner material by the liner-molding device. In particular, pads 5 engage the outer punch 7 and/or inner punch 8 of the liner-molding device during compression to allow gas to vent through the gaps 6 that would otherwise be trapped.

Figure 5 illustrates an enlarged cross-sectional view of the exemplary closure 100. As illustrated in Figure 5, the pads 5 have a height H from the top wall 1 and extend a distance D from a central longitudinal axis of closure 100.